A FUNCTIONAL COVER FOR USE WITH A WIRELESS TERMINAL.

Background of the Invention

5   The invention relates to a functional cover for use with a
wireless terminal, such as a cellular phone. Such covers
include functionality that is implemented by adding electronics
to the cover. The invention furthermore relates to the
mechanical and the electrical interface between a functional
10   cover and a wireless terminal.

Summary of the Invention

     According to a first aspect of the invention a method is
15   provided for operating an electric circuitry included in an
exchangeable cover part for supporting a user interface of said
wireless terminal. The wireless communication terminal and said
user exchangeable cover part are electrically interconnected by
means of an electrical connector having connector pins, and the
20   method includes identification of the type of said user
exchangeable cover part, and operating at least one of the
connector pins in an identification state for sensing a value
included in the identification means, and afterwards in an
operation state for operating the electric circuitry of the
25   user exchangeable cover part. Hereby the wireless terminal is
able to identify the type of the cover in a booting routine and
afterwards to operate the cover according to this. The cover
may have special illumination effect, special game keys,
special sound keys, special memories for playing music or
30   playing games.

Preferably the connector has a plurality of pins, and at least one of said connector pins is operated in an identification state for sensing a resistor value included in the identification means, and afterwards in an operation state for

5 operating the electric circuitry of said user exchangeable cover part.

According to a preferred embodiment of the invention, the operation state is a frequency mode for directing an electrical

10 representation of a ringing signal to the electric circuitry for providing an illumination effect following the ringing signal.

According to a further aspect, the invention relates to a

15 wireless communication terminal having a user exchangeable cover part, wherein the wireless communication terminal and the user exchangeable cover part are electrically interconnected by means of an electrical connector. The user exchangeable cover part comprises identification means, and an electric circuitry

20 for supporting a user interface of the wireless terminal. The wireless terminal identifies the user exchangeable cover part by detecting the identification means; and the connector includes a plurality of connector pins, where at least one of the connector pins is operated in an identification state for

25 sensing a value included in the identification means, and afterwards in an operation state for operating the electric circuitry of the user exchangeable cover part.

Preferably, the connector includes a plurality of connector

30 pins arranged in line in an equal distance. Advantageously, the connector pins are arranged at the rear side of the cover part. According to a preferred embodiment of the invention the number

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of connector pins is three. According to a further embodiment of the invention the number of connector pins is five.

Preferably, at least one of said connector pins is operated in
5 an identification state for sensing a resistor value included in the identification means, and afterwards in an operation state for operating the electric circuitry of said user exchangeable cover part.

10 In one implementation of the invention, the operation state is a frequency mode for directing an electrical representation of a ringing signal to the electric circuitry for providing an illumination effect synchronised with the ringing signal.

15 In a further aspect of the present invention the user exchangeable cover part may comprise one or more keys adapted to play at least one sound, the one or more keys being connected to the electric circuitry of the user exchangeable cover. The one or more keys may be mapped to a set of tones
20 and/or sound effects, which set of tones and/or sound effects may comprise Music Instrument Digital Interface (MIDI) tones (). The keys may be adapted for sound creating purposes, which may comprise music composing applications, sound creating applications, gaming, ring tone creation, system sound
25 creation, sending sounds with Multimedia Messaging Service (MMS) or other messaging services, or any combination thereof.

According to a further aspect of the invention a user exchangeable cover is provided for releasable attachment to a
30 wireless communication terminal, the user exchangeable cover has an electrical connector part for being electrically connected to the wireless communication terminal in attached position. The user exchangeable cover comprises identification

means, and an electric circuitry for supporting a user interface of the wireless terminal. The connector part includes a plurality of connector holes, where at least one of said connector holes is adapted to allow the wireless terminal to

5 operate the user exchangeable cover in an identification state for sensing a value included in the identification means, and afterwards in an operation state for operating the electric circuitry of said user exchangeable cover part.

10 The user exchangeable cover part may comprise one or more keys adapted to play at least one sound, the one or more keys being connected to the electric circuitry. The one or more keys may be mapped to a set of tones and/or sound effects, which set of tones and/or sound effects may comprise MIDI-tones. The keys

15 may be adapted for sound creating purposes, which may comprise music composing applications, sound creating applications, gaming, ring tone creation, system sound creation, sending sounds with MMS or other messaging services, or any combination thereof.

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Brief Description of the Drawings

For a better understanding of the present invention and to understand how the same may be brought into effect reference will

25 now be made, by way of example only, to the accompanying drawings, in which: -

Fig. 1 schematically illustrates a preferred embodiment of a wireless telephone according to the invention.

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Fig. 2 schematically illustrates a functional front cover for the wireless telephone shown in fig. 1.

Fig. 3 schematically shows the essential parts of a wireless telephone for communication with e.g. a cellular network.

Fig. 4 shows electrical connection between the main block of a
5   wireless telephone and a functional front cover according to preferred embodiments of the invention.

Fig. 5 shows the connection pad for connecting the wireless telephone and a functional front cover according to the
10   preferred embodiment of the invention.

Fig. 6 shows the preferred embodiment for the connector part mounted in the functional cover according to the preferred embodiment of the invention.
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Fig. 7 shows schematically in partial cross section the connector part connecting the main block of a wireless telephone and a functional front cover according to the preferred embodiments of the invention.
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Fig. 8 shows a flow chart illustrating the booting and mode selection procedure according to the preferred embodiment of the invention.

25   Detailed Description of the invention
     Fig. 1 shows a preferred embodiment of a wireless terminal, such as a cellular phone 1, which comprises a user interface having a keypad 2, a display 3, an on/off button 4, a speaker 5 (only openings are shown), and a microphone 6 (only openings
30   are shown).

According to the preferred embodiment of the invention the key-pad 2 has a first group 7 of keys as alphanumeric keys, two

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soft keys 8, and a scroll-key 10 (up/down) for moving a cursor
in the display. Furthermore the keypad includes two call-
handling keys 9 for initiating and terminating calls. The pre-
sent functionality of the soft keys 8 is shown in a separate
5   field in the bottom of the display 3 just above the soft keys
8.

The cellular phone 1 has an exchangeable functional front cover
25. An exchangeable front cover is intended to be changed by
10   the user himself without use of tools. Such an exchangeable
front cover is disclosed in US 09/503595 filed by the appli-
cant, and this disclosure is hereby incorporated by reference.
Fig. 2 shows the exchangeable functional front cover 25 accord-
ing to the invention.

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Fig. 2 schematically shows the most important parts of a pre-
ferred embodiment of the phone, said parts being essential to
the understanding of the invention. A processor 18, which sup-
ports the GSM terminal software, also controls the communica-
20   tion with the network via the transmitter/receiver circuit 19
and an antenna 20.

The microphone 6 transforms the user's speech into analogue
signals; the signals formed thereby are A/D converted in an A/D
25   converter (not shown) before the speech is encoded in an audio
part 14. The encoded speech signal is transferred to the proc-
essor 18. The processor 18 also forms the interface to a RAM
memory 17a and a Flash ROM memory 17b, a SIM card 16, the dis-
play 3 and the keypad 2 (as well as data, power supply, etc.).
30   The audio part 14 speech decodes the signal, which is trans-
ferred from the processor 18 to the earpiece 5 via a D/A con-
verter (not shown).

Furthermore a clock generator 24 supplies a clock signal to the processor 18. The processor 18 is via a three or five wire bus and a connector 41, 42, 44 connected to electronics 46 in the functional cover 25.

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A functional cover 25 is a cover for a wireless terminal 1, which includes functionality that is implemented by adding electronics 46 to the cover 25. To give some examples, it may include an application reacting e.g. to the power supply or ringing tone. It can also be an application that provides input to the phone (e.g. touch pad).

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The interface between the functional cover and the phone will be described. Five different modes will be introduced, out of which three are very simple and can be used for e.g. sensor applications. The remaining two modes are the generic asynchronous serial bus and a mode based on a synchronous data protocol.

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The objective of the invention is not to provide a full specification of all the different operation modes, but to allow functional covers and transceivers to interact, even through all the modes are not supported by both parts.

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According to the preferred embodiment of the invention the connector includes three connector pins, a positive power supply voltage pin (V_{DD}), a negative power supply voltage pin (V_{SS}), and a Cover Type Indicator pin (CTI).

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Preferably the CTI-pin (Cover Type Indicator) is a bi-directional and bi-mode (analogue/digital) signal pin. The CTI-pin is used for a frequency mode, a PWM-mode and a CTI-mode.

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According to an alternative embodiment of the invention the connector includes five connector pins. As for the first embodiment, the connector includes a positive power supply voltage pin (V_{DD}), a negative power supply voltage pin (V_{SS}), and a

5   Cover Type Indicator pin (CTI). Furthermore the connector includes a Data Signal pin and a Clock Signal pin.

The Data Signal pin is used for asynchronous data in data mode and in a synchronous data mode. The protocol for the synchro-

10   nous data mode may be according to the I2C-Bus Specification, version 2.1, January 2000. The Clock Signal pin is used for the clock in synchronous data mode.

Pin	Output type	Description	Communication direction
Vdd		Power supply	Transceiver to Functional cover
Vss		Ground	Transceiver to Functional cover
CTI	Analogue	Frequency output	Transceiver to Functional cover
	Digital	PWM output	Transceiver to Functional cover
	Analogue	Cover Type Indicator	Functional cover to Transceiver
	Digital	PWM input	Functional cover to Transceiver
Data	Digital	Asynchronous data output	Transceiver to Functional cover
	Digital	Synchronous data output	Transceiver to Functional cover
	Digital	Asynchronous data-input.	Functional cover to Transceiver
	Digital	Synchronous data input	Functional cover to Transceiver
Clock	Digital	Clock output	Transceiver to Functional cover
	Digital	Clock input	Functional cover to Transceiver

15   Table 1 Functional cover interface pins

According to the invention, a baseband engine and a functional cover do not have to support all the modes. This means that the

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physical interface may comprise from three to five pins depending on the number of supported modes.

5　If the BB engine supports multiple modes, passive mode is not allowed to affect the active mode. This means for example, when making the CTI measurement, other pins driving the CTI-pin must have high impedance. Furthermore the baseband engine must be able to drive R_{CTI}.

10　When the wireless terminal 1 is switched on, or the processor 18 detects that a new functional cover has been attached to the transceiver part, a boot sequence is initiated. During the boot, the type of the cover is detected via the CTI signal. According to that information, the corresponding data mode is se-
15　lected and the appropriate power supply level, V_{dd}, is supplied. An example of the boot sequence and mode determination process is presented in fig. 8.

First the power is switched on to the phone in step 100. Then
20　the size of the CTI-resistor, R_{CTI}, is measured in step 101. If the resistor measurement result in step 102 does not exceed a predetermined value (e.g. 750 kOhm), the functional cover is deemed to be attached and a further investigation in order to identify the cover, has to be done. If the resistor measurement
25　result in step 102 exceeds the first predetermined value, the functional cover is deemed to be present. The booting in step 103 has to be continued under the presumption that the cover does not support the electric interface according to the invention.
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If the processor 18 in step 104 identifies that the cover is "intelligent", this means that the cover 25 has an asynchronous or synchronous data interface, further information will be ex-

changed via the digital interface in step 105. The digital interface and the power scheme have to be defined. Hereafter the booting with be continued in step 106.

5 If the cover in step 104 is deemed not to be "intelligent", the CTI-resistor, R_{CTI}, is compared with a second threshold (e.g. 64,9 kOhm) and a third threshold (e.g. 93,1 kOhm), the cover 25, is deemed to have passive components only, and these components are powered by the power supply of the wireless terminal
10 1. The voltage is determined by the processor 18 in step 108 by means of a look-up table. The booting is continued in step 109.

If the CTI-resistor, R_{CTI}, falls outside the interval defined by the second and the third threshold, the cover 25 is deemed to
15 be able to perform other modes as a pulse mode, a PWM mode or a frequency mode. The mode and power scheme are determined by the processor 18 in step 110 by means of a look-up table. The booting is continued in step 111.

Mode	R_CTI value
Synchronous data mode	2.00 kOhm
Asynchronous data mode	6.65 kOhm
PWM data mode	30.90 kOhm
	45.30 kOhm
	64.90 kOhm
CTI data mode	93.10 kOhm
	137.0 kOhm
Freq. data mode	210.0 kOhm
	357.0 kOhm
	750.0 kOhm
NO COVER	∞

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Table 2 mode supported in dependence of the impedance R_{CTI}.

Table 2 above describes the CTI resistor value R_{CTI} vs. func-
tionality conversion. The whole conversion range is preferably
divided into a predetermined number of different sub-ranges.
5   For the "intelligent" modes (synchronous and asynchronous),
only one resistor value has been reserved, since all the needed
additional information can be transferred via the interface.
For PWM- and CTI-modes, two resistor values are reserved and
for the Frequency-mode, four resistor values have been re-
10 served.

The power control scheme is based on the CTI-information, which
is defined in the table 2. The electrical parameters of the
power supply include the power supply voltage VDD, the output
15 current IDD. The output impedance ZOUT of the wireless terminal
is 1, and the power on time and power off time.

Data interface Synchronous mode (Data and Clock pins)

20 The data specification used according to the invention may be a
sub set of I2C-bus specification version 2.1, January 2000, by
Philips Semiconductors. In the synchronous data mode the data
pin is used for transferring data between the wireless terminal
1 and the functional cover 25, usually under control of the
25 processor 18 and the clock oscillator 24 associated therewith.

Data interface asynchronous mode (Data pin)

Data is transferred in the asynchronous data mode based on an
30 asynchronous half-duplex signal. The power supply may be in the
level of V_{DD} = 2,7V with a data rate of up to 230 kbps.

The asynchronous data mode as well as the synchronous data mode
may be used for loading data from multi-media memory card (MMC)
like memories included in the functional cover 25 into the
5   wireless terminal for being handled by means of the processor
18. Such a data connection may be used for loading data from
multi-media memory card (MMC), like memories included in the
functional cover 25, into the wireless terminal for being han-
dled by means of the processor 18. These data may include, e.g.
10   MP3 music files and executable games. Hereby it has become pos-
sible to provide a gaming cover, perhaps having an extra joy-
stick, whose operation is sensed by the gaming cover and trans-
ferred to the wireless terminal via the data pin. The game may
also be run on an extra processor included in the functional
15   cover 25, but using the display 3 of the wireless terminal 1.
Extra UI units as a touch sensitive pad/screen or an extra dis-
play may be provided on the functional cover 25 and controlled
by the processor 18.

20   Alternatively, the functional cover 25 is adapted for a music
composer application or any sound creating application desig-
nating keys to be assigned to tones and/or sound effects. A de-
fault mapping between the keys and a set of tones and/or sound
effects is provided. However, a user is enabled to select a
25   number of tones and/or sound effects, and to map these tones
and/or sound effects to the keys. Repeated tone, fading tone or
any other sound may be mapped to e.g. pressing a key for a par-
ticular long period of time or pressing a key together with a
shift key. The tones and/or sound effects comprise sounds pro-
30   vided by the wireless terminal 1, and/or MIDI-tones.

The MIDI protocol is an entire music description language in
binary form. Each word describing an action of musical perform-

ance is assigned a specific binary code. The protocol also in-
cludes percussion oriented actions. To sound a note in MIDI
language a "Note On" message is sent, and then a note "veloc-
ity" is assigned, which determines how loud the note is played.

5   Other MIDI messages include selecting which instrument to play,
mixing and panning sounds, and controlling various aspects of
electronic musical instruments. Normally, a wave table compris-
ing available sounds is used for sound creation according to
the MIDI music description. While MIDI is musical performance

10   information, the term MIDI-tones is here the audio output from
the entire MIDI system.

Further, the functional cover 25 comprises memory and process-
ing capabilities so as to provide an ability to create sounds.

15   The memory may comprise wave tables, sound clips, or any other
sound information required by said music composer application
or sound creating application. Processing capabilities are
needed for audio processing. Processing capabilities and memory
may be located in the functional cover 25, in the wireless ter-

20   minal 1, or any combination thereof.

The sound creating capabilities are used for music composing
applications, sound creating applications, gaming, ring tone
creation, system sound creation, sending sounds with MMS (Mul-

25   timedia Messaging Service) or other messaging service, or any
combination thereof.

PWM data mode (via CTI-pin)

30   Data is transferred using bi-directional CMOS level PWM-
modulated CTI-signal. The power supply may be in the level of
V_{DD} = 2,7V. The pulse signal may have a variable frequency up
to 32 kHz. The pulse duty cycle may be varied between 0,01 and

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1. This is an analogue signal in digital format, whereby a sound can easily be transferred ref. buzzer signal.

CTI data mode (via CTI-pin)

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The type information of the cover is given in the CTI. I.e. the processor 18 detects the value of the pull down resistor during the start-up (boot) of the phone and selects the right data and power interface mode according to the predefined table.

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This mode is very applicable for applications that do not need any stimulus from the wireless terminal. A flashlight is a good example of such an application.

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Frequency mode (via CTI-pin)

In the frequency mode, the functional cover 25 is controlled
20 with the frequency of the CTI-signal. Amplitude information is not needed. Therefore the driving signal can be a small analogue voltage, which is then amplified in the cover end. The frequency signal may according to the preferred embodiment be variable up to 10 kHz.

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This mode can be used to direct a ringing tone to the functional cover 25. Once there, it can be used as a stimulus, for example driving a "light organ".

30 The connector interface may comprise three to five pins and associated pads. The electrical requirements for different signal pins will probably be quite different. The CTI-pin will be used for low, whereas clock and data will be used for medium bandwidth communication. For high bandwidth communication

something more sophisticated is needed. As a result, the connector has to be designed with a view to optimising the connector with regard to performance and cost.

5   The interface on the wireless terminal comprises three to five signal pads for interacting with a similar amount of pogo pins 41, which are included in the cover 25.

Pin name	Pin no	A	D	Unit
CTI	1.	4.3	2	mm
V_{SS}	2.			
V_{DD}	3.			
Data	4.			
Clock	5.			

10   Table 3 - Pin order and pad sizes

The order of the pins appears from fig. 4 and 5. The pins 41 are arranged in a line in equal distance, A. The diameter, D, of the five pads 44 is substantially greater than the diameter

15   of the plungers 42 of the pins 41 in order to ensure a reliable connection.

It shall be noted that the wireless terminal 1 may have five pads 44. If the functional cover does not support the data

20   modes, only three pins 41 are needed, and these three pins 41 engage the pad 44 corresponding to pins no 1-3.

The connector according to the preferred embodiment of the invention comprises three Pogo-pins 41 (spring-loaded contacts)

25   mounted on a rigid Printed Wiring Board 40.

The pogo-pins 41 are mechanically fixed and soldered on the Printed Wiring Board 40 in order to maintain safe and low resistance contact between the phone's main Printed Wiring

30   Board and Functional Cover's small rigid Printed Wiring Board 40. A plunger 42 travel should be at least 1 mm, and the

pressure force between plunger and main Printed Wiring Board's
pads should be minimum 25 g for use in a standard wireless
terminal. The pad dimensions and spacing are given in table 4
above.

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Pins may advantageously be gold-plated, and their internal
resistance has to be specified according to the application.
Preferably the internal resistance does exceed 100 mΩ even
after 10,000 cycles.

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Fig. 7 shows the wireless terminal 1 with the front cover 25
lifted. The pads 44 are arranged on the printed wiring board 43
of the terminal. The printed wiring board 43 is covered by a
light guide 45 of transparent plastic, which has openings
15   allowing the con-nector pins 41,42 to access the pads. The
connector pins 41,42 are mounted on a printed wiring board 40.

The printed wiring board 40 is mounted on the inner side of the
cover 25 by means of snap coupling means 48. On the rear side
20   of the printed wiring board 40 an electric circuitry is
provided including e.g. three LED's 47 illuminating respective
pipe formed light-guides 49. In the frequency mode an
electrical representation of a ringing signal is directed to
the electric circuitry for providing an illumination effect
25   following the ringing signal. The light-guides 49 may be
illuminated individually in a tempo following the ringing
signal. This gives an exciting effect for the user when the
functional cover 25 is partly transparent.

30   What is claimed is: -